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Finger nail traction and digital splint in the management of proximal phalangeal fractures

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Abstract
Introduction: Proximal phalangeal fractures are common fractures of the hand. There is vicinity of two important joints and crossing of long tendons which make these fractures difficult to treat. The goal of this study was to evaluate the efficacy of nail traction technique in the management of proximal phalangeal fractures of the hand.
Material and Methods: This is a prospective study of patients with proximal phalangeal fractures treated by nail traction. Assessment of all patients was done at the time of presentation and there was a standard protocol which was followed for recruiting patients. Assessment of the patients initially was done on 12th day after the application of nail traction. The outcome measures included radiographic evaluation post reduction and total active motion (TAM) in the finger at the final follow up. Follow up of all patients was done for a period of one year.
Results: On x-ray evaluation post reduction, good reduction was seen in 33 cases, 8 cases had fair reduction and poor reduction in 2 cases. At final assessment, 35 patients had good, six had fair and two had poor TAM score. Complications were noted in two patients, which included pressure necrosis in palm and stiffness in proximal interphalangeal joint.
Conclusions: The results of this study showed that nail traction seems to be simple, safe and effective technique for managing proximal phalangeal fractures.

Keywords: Proximal phalangeal fractures, conservative treatment, nail traction, hand fractures, digital splint

Introduction
The most common sites for fractures in the hand are the phalanges [1, 2]. If these fractures are not managed adequately, they can result in long lasting deformity due to reduction in the range of motion in the adjacent joints [3]. 2.9 % is the incidence of phalangeal fractures annually. These are commonly seen in age groups of 20-29 years in males [3-7]. 13 % of all hand fractures are constituted by phalangeal fractures. Various mechanisms cause these fracture, however road traffic accidents, industrial injuries, falls and sports related injuries are some of the common mechanism causing these fractures. Irrespective of the mode of treatment, proximal phalangeal fractures are difficult to treat. If we try for surgical stabilization, there may be further tissue trauma resulting in the reduction in the range of movements in the adjacent joints and adherence of soft tissue. There may also be interference of the internal fixation device with the tendon gliding. On the other hand, conservative techniques such as splints and braces may not be able to maintain the reduced position. This may result in malunion or delayed union. Prolonged mobilization in these joints may cause stiffness and require long term physical therapy. Early mobilization to prevent stiffness and obtaining fracture union in acceptable alignment are the main objectives of treating hand fractures [6, 7]. The proximal phalangeal fractures are usually held in reduction with the metacarpophalangeal joint flexed at 90 degrees [5, 8]. The collateral ligaments of the MCP joint in flexed position are taut with minimal chances of stiffness due to contracture. Volar plate contracture is prevented by keeping the proximal interphalangeal joints in extension. Dorsal and volar stability is achieved by the tensed extensor and flexed tendons which is provided by the longitudinal traction given. This study reports the findings of the proximal phalangeal fractures managed by a nail traction technique. Longitudinal traction was applied through the finger nail. The soft tissues around the proximal phalanx were made tense with traction to provide stability and maintain reduction.

Methods

Study Design

In our study 106 consecutive phalangeal fractures were managed. A total of 70 of these fractures were fractures of the proximal phalanges and out of these 43 fractures were selected for nail traction. The criteria for recruitment of these patients is shown in Figure 1.

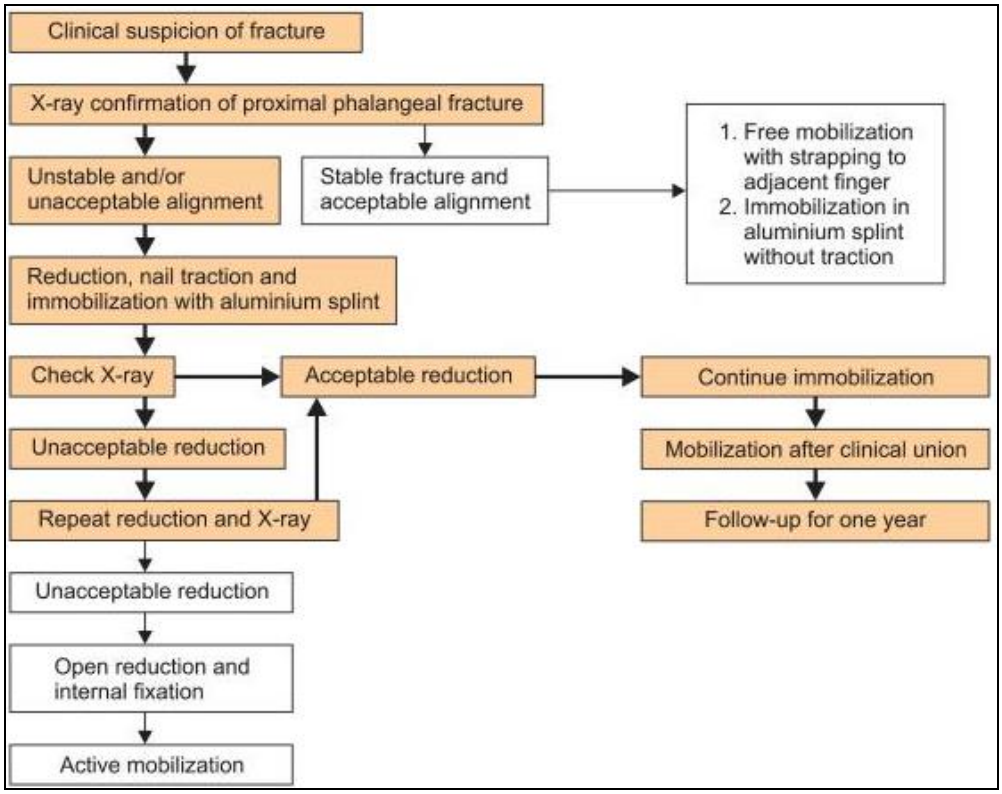

Fig 1: Study protocol and criteria for recruiting the cases for study. The bold arrows and shaded boxes show the criteria for including patients for the study.

Inclusion criteria included one or more of the following:

1) Functionally stable fractures

The criteria used for functionally stability was that described by Pun *et al*. [9] Functionally stable fractures were those in which the patients could actively move the adjacent joints (MCP and PIP joints) more than 30 percent of the expected range and in which the alignment of fractures remained within acceptable range.

2) Unacceptable radiographic alignment

Angulation less than 10 degrees in both coronal and sagittal planes was considered acceptable.

3) Type 1 open fracture according to classification described by Swanson *et al*. [10]

There were other methods used to treat proximal phalangeal fractures which did not meet the inclusion criteria. These included aluminium splint alone without traction for four cases, strapping and mobilization for six cases, surgical stabilization in eleven cases, scaphoid slab after reduction for six cases. The patients were initially assessed and informed consent was obtained for the procedure and for inclusion in the study.

Technique for applying nail traction

Figure 2A-C shows the steps for application of nail traction. A digital block was given with 2 percent plain lidocaine to the injured finger. This was done under aseptic conditions. This was followed by use of a cutting needle suture of 3.0 prolene to take a bite at the distal one third of the nail (non-germinal part) from distal to proximal with the needle caressing between nail and nail bed. A second bite was then taken in the reverse direction and the ends of the suture were left free at this stage.

Fig 2: Steps in application of nail traction. After passing the suture through the nail the aluminium splint is bent and incorporated in the plaster of Paris (POP) cast (A). Then the free ends of sutures are tied over the aluminium splint (B). The final bandage is applied over the POP slab to secure the position of slab with traction splint (C).

The aluminium splint was pre bent before incorporating it in the below elbow slab. The first bend measuring 90 degrees was at one inch from the distal end. The next bend was made measuring and angle of 70 degrees to 80 degrees to accommodate the MCP joint. The third bend was made measuring an angle of 45 degrees to accommodate the wrist dorsiflexion.

This was followed by incorporation of the aluminium splint in below the elbow POP slab by sandwiching it in between the two sets of POP slab. The tip of the finger was held and the fracture was reduced. The free ends of the prolene were tied to the distal bent part of the aluminiumsplint (Figure 2B). Adhesive tape was used to firmly secure the knot to the aluminium splint to prevent it from slipping. The amount of force for traction was variable and this force was equivalent to the force required just to maintain the fracture in reduced position without distraction.

Gauze rolled into balls were kept in between the splint and the finger at the apex of the deformity to nullify the deforming forces and bandage applied to secure the cast in place (Figure 2C). It was made sure that the finger nail was parallel to the horizontal before application of the bandage with the MCP joint flexed at 90 degrees to prevent rotational deformity. Radiographs were taken in AP and Lateral views (Figure 3).

Fig 3: Pre-reduction image of proximal phalangeal fracture showing dorsal angulation.

Immobilization and rehabilitation

If the alignment was acceptable (Figure 4) then the immobilized splint was continued with the patient being advised to keep the hand elevated during the first week. Clinical union was tested after twelve days by eliciting tenderness at fracture site. The splint was discarded if there was no tenderness and protected mobilization was started by the physiotherapist with adjacent finger strapping which continued for one week. Free active assisted mobilization was initiated until full recovery was achieved. The splint was continued for a maximum of another week even though the traction was released if the fracture site was tender. The recovery time ranged from six to eighteen weeks but all the patients were followed up for one year.

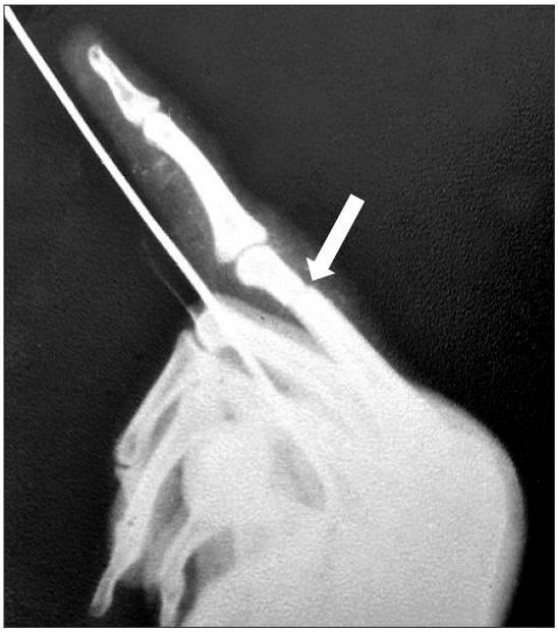

Fig 4: Immediate post-reduction image of the fracture shown in Fig. 3. After application of finger nail traction the position was accepted.

Outcome measures

The outcome measure we used in this study included post reduction radiological evaluation and total active motion at final assessment.

The following criteria were used for post reduction radiological evaluation

1) Good – Angulation less than ten degrees in both planes.
2) Fair – Angulation between eleven and twenty degrees.
3) Poor – Angulation more than twenty degrees and any degree of rotation.

The results were graded into three grades based on total active motion (TAM)

1) Good – TAM 210 degrees or more
2) Fair – TAM between 180 degrees -210 degrees
3) Poor: TAM less than 180 degrees

Results

Out of 70 proximal phalangeal fractures, 43 were managed by nail traction. Of the remaining 27 fractures, other methods were used for management, four were treated by aluminum splint alone without traction and strapping and mobilization was done for six patients. Another six were managed with a scaphoid slab after reduction, and surgical stabilization was used in eleven cases. Only those cases which had nail traction were included in this study. This study included 25 (58%) male and 18 (42%) female patients. The left hand was injured in 23 of these patients and the right hand in 20. The average age was 32 years (range, 13 to 69 years). Majority of the patients (n=20) were between 25 to 50 years of age. Among the remaining patients, 17 were below 25 years of age and 6 were above 50 years. The various mechanisms of injury to these patients included industrial/workplace injuries (13), assault (6), road traffic accidents (7), domestic injuries (12) and sports injuries (5). Among the 43 patients, 24 were manual labourers or construction workers, 11 housewives, 3 students and 5 office workers.

The classification of proximal phalanx fractures was done as open or closed. The classification was further bases upon the location and configuration of the fracture. Different fracture patterns and post reduction X-ray evaluation are shown in Table 1. The number of open fractures were five and closed fractures were 38. There was involvement of the middle finger in 15 cases, the ring finger in 12 cases, the index finger in 10 cases and the little finger in 6 cases. The shaft of the proximal phalanx was the most common location which was involved in 28 fractures. This was followed by proximal metaphyseal fractures (11 cases), neck fractures (2 cases) and epiphyseal fractures (2 cases). After assessment of the fracture configuration, we found that there were 18 transverse fractures, 15 oblique fractures and 6 comminuted fractures. The remaining four fractures involved the proximal metaphysis but could not be classified into transverse, oblique or comminuted. Out of the remaining four fractures, two were epiphyseal fractures and two had intra articular extension.

Table 1: Types of fractures and post-reduction X-ray evaluation after first reduction and application of nail traction.

Type of fracture	Total no.	Open	Closed	Post reduction X-ray evaluation		
				Good	Fair	Poor
Shaft-transverse	14	1	13	12	2	
Shaft-oblique	8	1	7	7	1	
Shaft-comminuted	6	3	3	3	2	1
Distal metaphysis	2		2	1	1	
Proximal metaphysis	9		9	6	2	1
Proximal metaphyseal with articular extension	2		2	2		
Type 2 epiphyseal	2		2	2		
Total	43	5	38	33	8	2

The post reduction radiographs were graded as good, fair and poor depending upon the angulation at the fracture site. 33 cases showed good reduction while fair and poor reduction was seen in eight and two cases respectively. The patients that came with fair or poor reduction had repeat reduction and a repeat radiograph so that we could achieve acceptable reduction.

Functional assessment was done at the final follow up which has been documented in Table 3. 35 patients achieved good reduction while fair reduction was achieved in six patients. Poor function (TAM less than 180 degrees) was noted in two patients. When compared to post reduction radiological evaluation, there was a shift of from fair to good results in two cases. This was probably achieved by early mobilization.

Table 3: The total active motion (TAM) scores were recorded at final follow up.

Type of fracture	Total no.	TAM score		
		Good	Fair	Poor
Shaft-transverse	14	13	1	
Shaft-oblique	8	6	2	
Shaft-comminuted	6	4	1	1
Distal metaphysis	2	2		
Proximal metaphysis	9	6	2	1
Proximal metaphyseal with articular extension	2	2		
Type 2 epiphyseal	2	2		
Total	43	35	6	2

Two patients showed complications of this procedure which included pressure necrosis due to the aluminium splint at the 5th metacarpal head and stiffness in the PIP joint. The conclusion we came to was that the pressure necrosis may be a result of inadequate padding under the aluminium splint. The patient who presented with the complication of pressure sore required flexor sheath release. Scar massage and physiotherapy was started for patient with stiffness and extensor lag. This patient had an open wound on the dorsum of the finger at the time of injury. This patient eventually had a complete recovery.

Discussion

The presence of an important join on either end of the bone make fractures of the proximal phalanx in the hand difficult to treat [11, 12]. Important flexor and extensor tendons cross this bone for distal attachment. The aim of treatment in these fractures is not only to achieve union with a good alignment but also the gliding mechanisms of the tendons must be preserved. The fracture adapts a palmar apical configuration with the proximal fragment in flexion and the distal fragment in extension, all this of which is seen in the sagittal plane. The proximal fragment is in flexion because of the flexion of the MCP joint caused by the intrinsic muscles. The distal fragment goes into extension due to short excursion of the extensor tendon hood and lateral bands [5]. When reduced properly, the fracture can be held by using a splint with traction and the stabilizing effect of tense soft tissues [13].

Various treatment options are present for the management of these fractures. These include open reduction and internal fixation, external fixators, and conservative modalities. Open reduction and internal fixation can cause further soft tissue damage which may result in impairment of the gliding layers [12, 14, 15]. However, surgical management becomes necessary in unstable, irreducible and open fractures with soft tissue damage. 11 cases were treated with internal fixation. Out of these 11 fractures good results were seen in 4(36.3%) cases, fair in 4(36.3%) and poor in 3(27.2%).

Patients if treated with conservative management showed avoidance of soft tissue damage and were associated with less loss of range of motion in the adjacent joints if early mobilization is guaranteed [5, 6]. However, it is important to appreciate that the conservative treatment is only effective when intact muscle tendon units and other soft tissue can be utilized to hold the reduction [5].

There have been previous studies on management of proximal phalangeal fractures with traction splints. Koul *et al* [13] reported the results of 39 proximal phalangeal factures treated with a custom made traction splint. They used adhesive glue to fix the traction to an over nail plate and reported excellent results in 72% of the patients, good results in 22% and poor results in 6%. None of the patients in this group with transverse fractures were treated by traction splint, they suggested that internal fixation is more favourable for transverse fractures. In our series 18 (42%) cases of transverse fractures were treated by digital splint and nail traction. This shows that if good reduction is achieved under digital block and then maintained with longitudinal traction and proper splinting, then transverse fractures can be treated successfully with traction splints.

Rajesh *et al* [12] used a thermoplastic MCP block splint for proximal phalangeal fractures in 32 cases. They did not apply traction on the finger. In their series they reported excellent results in 72%, good in 22% and fair to poor in 6% of the cases. However, their results for patients younger than 50 years were significantly better compared to older patients. They suggested the splint to be continued for 3 to 4 weeks while in our study the splint was removed at the 12th day in more than 80% of cases. We think early protected mobilization is important to prevent stiffness in adjacent joints.

Complications were recorded by us in two cases. One patient had pressure necrosis of a small area over the 5th metacarpal head. Better padding could have helped us to avoid this complication. The area of necrosis was small but the patient eventually needed flexor sheath release. Stiffness in the PIP joint was reported by the second patient. This patient had an open fracture and the wound on the dorsum of the proximal phalanx was closed before the application of nail traction. Scar massage and physiotherapy was started for this patient. No infection nor any nail bed complications were reported in this series.

The results from this series show that nail traction with digital splint is an effective and safe technique. It is very simple and easy to learn. The aluminium splint can be easily incorporated between layers of the POP slab. It involves a single stitch through the finger nail under local anaesthesia. Most of our cases were closed fractures but open fractures without significant soft tissue damage can be primarily closed and treated by nail traction.

References

1. Barton NJ. Fractures of the shafts of the phalanges of the hand. Hand. 1979; 11(2):119-133.
2. Crick JC, Franco RS, Conners JJ. Fractures about the interphalangeal joints in children. J Orthop Trauma. 1987; 1(4):318-325.
3. De Jonge JJ, Kingma J, van der Lei B, Klasen HJ. Phalangeal fractures of the hand: an analysis of gender and age-related incidence and aetiology. J Hand Surg Br. 1994; 19(2):168-170.
4. Butt WD. Fractures of the hand. I. Description. Can Med Assoc J. 1962; 86(16):731-735.
5. Burkhalter WE, Reyes FA. Closed treatment of fractures of the hand. Bull Hosp Jt Dis Orthop Inst. 1984; 44(2):145-162.
6. Capo JT, Hastings H., 2nd Metacarpal and phalangeal fractures in athletes. Clin Sports Med. 1998; 17(3):491-511.
7. Reyes FA, Latta LL. Conservative management of difficult phalangeal fractures. Clin Orthop Relat Res. 1987; (214):23-30.
8. Ryes F. Dynamic closed treatment of proximal phalanx fractures; 38th American Society for Surgery of the Hand Annual Meeting; Anaheim, CA, USA, 1983, 7-9.
9. Pun WK, Chow SP, So YC *et al*. A prospective study on 284 digital fractures of the hand. J Hand Surg Am. 1989; 14(3):474-481.
10. Swanson TV, Szabo RM, Anderson DD. Open hand fractures: prognosis and classification. J Hand Surg Am. 1991; 16(1):101-107.
11. Maitra A, Burdett-Smith P. The conservative management of proximal phalangeal fractures of the hand in an accident and emergency department. J Hand Surg Br. 1992; 17(3):332-336.
12. Rajesh G, Ip WY, Chow SP, Fung BK. Dynamic treatment for proximal phalangeal fracture of the hand. J Orthop Surg (Hong Kong). 2007; 15(2):211-215.
13. Koul AR, Patil RK, Philip V. Traction splints: effective non-surgical way of managing proximal phalanx

fractures. J Trauma. 2009; 66(6):1641-1646.
14. Barton NJ. Fractures of the hand. J Bone Joint Surg Br. 1984; 66(2):159-167.
15. Pennig D, Gausepohl T, Mader K, Wulke A. The use of minimally invasive fixation in fractures of the hand - the minifixator concept. Injury. 2000; 31(1):102-112.
16. Tubiana R. Early mobilization of fractures of the metacarpals and phalanges. Ann Chir Main. 1983; 2(4):293-297.